Scour and Fill On a Small Tributary to the Virgin River

U.S. DEPARTMENT OF THE INTERIOR
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Beaver Dam Wash originates in the Bull Valley mountains of southwestern Utah and flows west (through Nevada) and south (through Utah and Arizona) as it drains toward its confluence with the Virgin River (Figure 1). The stream flows through approximately 8.4 miles of northwestern Arizona, including about 1.25 miles of public land administered by the U.S. Bureau of Land Management (BLM). Perennial flow in this interrupted stream occurs in southwestern Utah, southeastern Nevada, and above the confluence with the Virgin River near Beaver Dam, Arizona.

The public land surrounding the confluence of Beaver Dam Wash and the Virgin River is a very dynamic landscape maintained by extremely active channels of these two desert streams. Flood events in either of these two drainages have a pronounced effect on channel location and morphology for both streams. Channel evolution in time and space create a variety of habitats for both aquatic and riparian species. It is the dynamic nature of the processes active here, along with the dependable supply of relatively high-quality fresh water, that gives this area its high resource values.

The dynamic nature of the Virgin River channel is documented in Figure 2, depicting a sequence of aerial photographs of the confluence area over the last 30 years. In the earliest photos (1966 and 1976), the Virgin River is actively eroding the outside of its meander bend on the western half of the public land. The mouth of Beaver Dam Wash is distributary, and a Virgin River overflow channel is present near the eastern border of the public land. In the later photos (1980 and 1991), the main channel of the Virgin River has occupied the position of the previous overflow channel near the eastern edge of the public parcel. The last photo (1991) reveals a single channel for Beaver Dam Wash and bank erosion along the southernmost edge of the Virgin River meander.

Extremely active channels, as evidenced in this area by the Virgin River, are common among desert streams. Storm-driven runoff and predominantly sandy bed material are generally responsible for this kind of channel behavior. The location of the Beaver Dam Wash confluence on the outside of a meander bend renders the processes particularly noticeable in this area. Constriction of the valley walls just downstream of the confluence (under the interstate highway bridge) also may enhance these processes by creating a backwater condition on the Virgin River during exceptionally large flood events (such as the flood from the dam break in 1989). The general character of desert streams and the specific characteristics of this site make it a classic location for investigation of geomorphic processes.

Superimposed on the geomorphic processes of the Virgin River are the large flood events experienced in the Beaver Dam Wash drainage. Floods in Beaver Dam Wash are commonly produced by summer thunderstorms and winter frontal rains; however, the longer duration of runoff associated with frontal systems generally causes much greater changes in channel morphology. Channel evolution during and after these flood events produces a wide variety of aquatic and riparian habitats, even over a relatively short period of time.

Figures 3 through 8 provide an impressive demonstration of dynamic channel evolution in Beaver Dam Wash over a period of about 5 years. The earliest photographs (Figure 3) were taken in the fall of 1991 and represent an advanced ecological condition for the channel and riparian area on public land. The channel was narrow, with well-vegetated banks and bed material armored with gravel and small cobble. Overhanging vegetation and woody material provided good aquatic habitat, and riparian vegetation showed diversity of composition and structure.

Channel conditions changed dramatically following a moderately large flood in the spring of 1992 (Figure 4). Channel width increased substantially, and bed materials were widely sorted. Succession of riparian vegetation was reset to an early seral condition, with willows and cottonwoods attempting to recolonize fresh sediment deposits. Cover for aquatic species also was reduced substantially.

Changes in channel morphology and riparian condition were extreme following a major flood in the winter of 1993 (Figure 5). Estimated peak flows of approximately 6,000 cfs (USGS 1994) produced dramatic increases in channel width and new sites for riparian reproduction. Diversity of aquatic habitat was greatly reduced, as channel units (e.g., pools and riffles) were obliterated and woody debris was removed from the system. The channel was in a very early ecological state, and processes of channel evolution and ecological succession were reset to initial conditions.

Conditions depicted in the three previous photographs were repeated in less than 2 years following the 1993 floods. Figure 6 reveals a moderately advanced ecological condition that had developed along the channel by the summer of 1994. Again the streambanks were well vegetated, providing shade, cover, and allochthonous material to the channel. Figures 7 and 8 depict conditions following a moderate and a major flood, respectively, during the winter of 1995. Resulting channel conditions are similar to those described above.

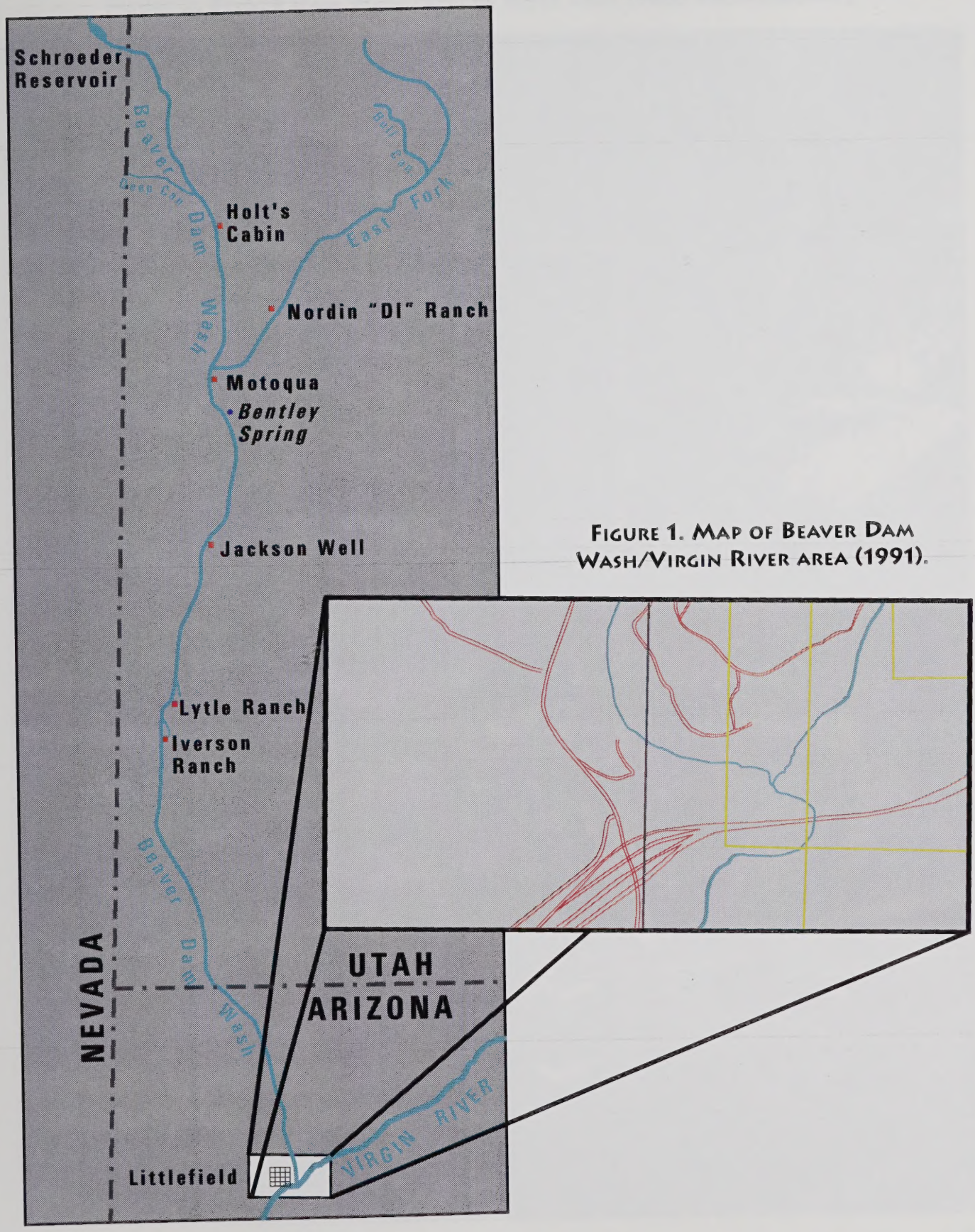


FIGURE 1. MAP OF BEAVER DAM WASH/VIRGIN RIVER AREA (1991).

FIGURE 2. BEAVER DAM WASH/VIRGIN RIVER AREA (1966 PHOTOGRAPHY).

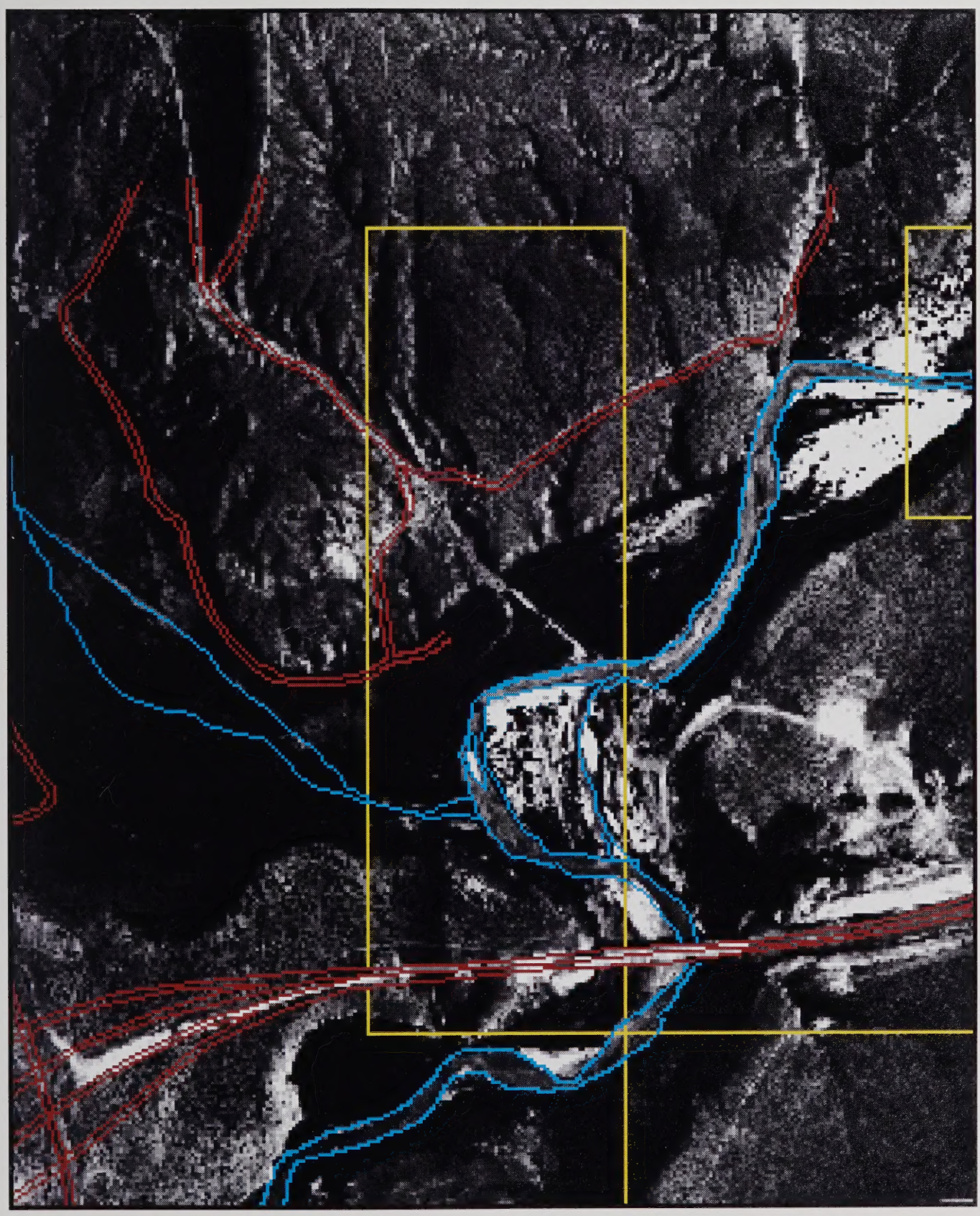


FIGURE 2 (CONTINUED). BEAVER DAM WASH/VIRGIN RIVER AREA (1976 PHOTOGRAPHY).

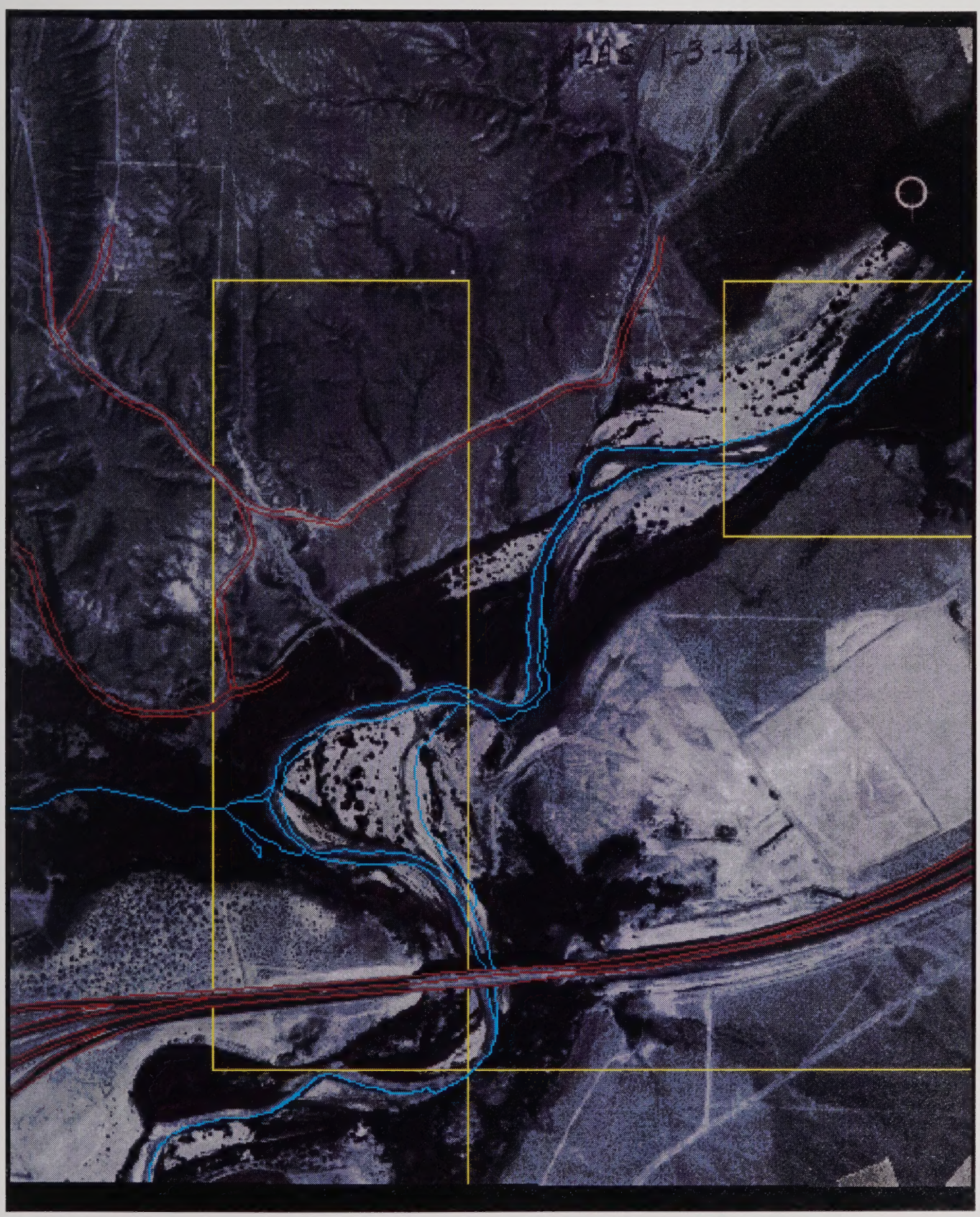


FIGURE 2 (CONTINUED). BEAVER DAM WASH/VIRGIN RIVER AREA (1980 PHOTOGRAPHY).

FIGURE 2 (CONTINUED). BEAVER DAM WASH/VIRGIN RIVER AREA (1991 PHOTOGRAPHY).

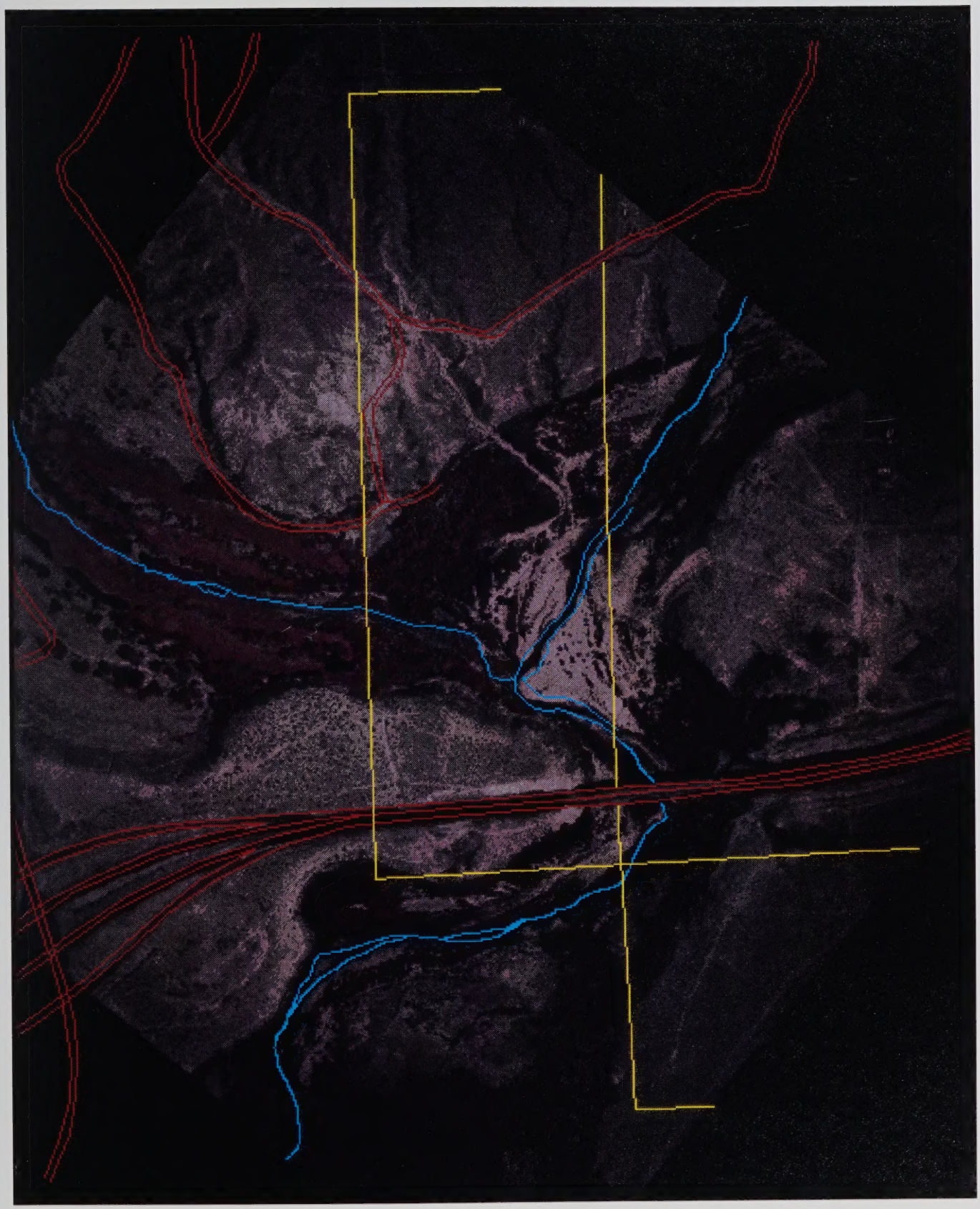


Figure 3. Photos taken on 9/13/91 showing advanced ecological condition.

Figure 4. Photos taken on 8/17/92 and 10/15/92 showing effects of moderate flood durring spring, 1992.

Figure 5. Photos taken on 9/8/93 showing effects of major flood during winter, 1993.

Figure 6. Photos taken on 8/24/94 and 10/13/94 showing moderately advanced ecological condition.

Figure 7. Photos taken on 2/17/95 showing effects of moderate flood during winter, 1995.

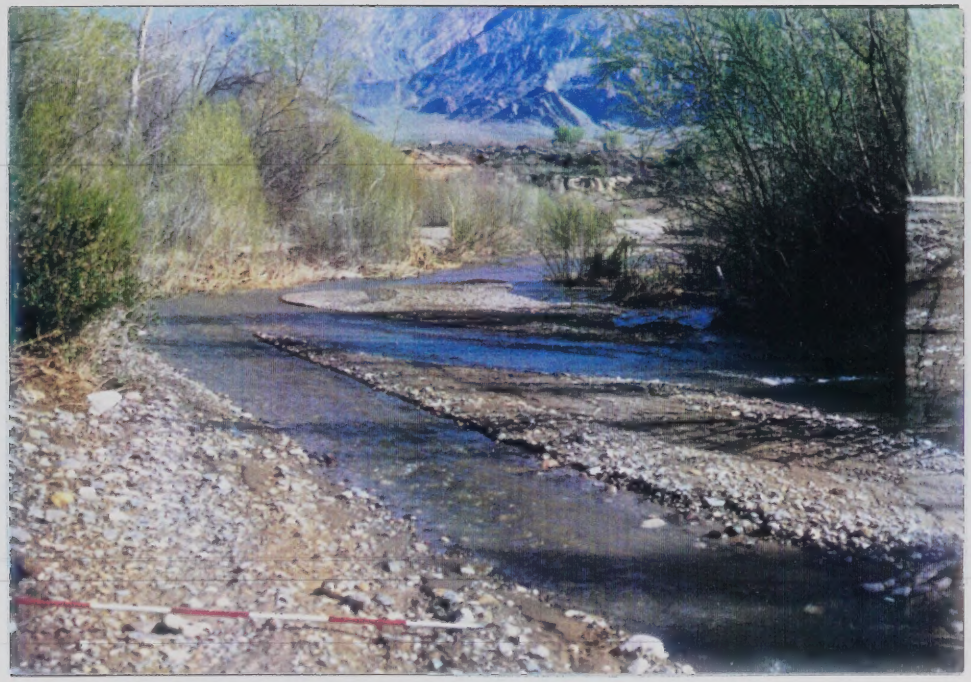
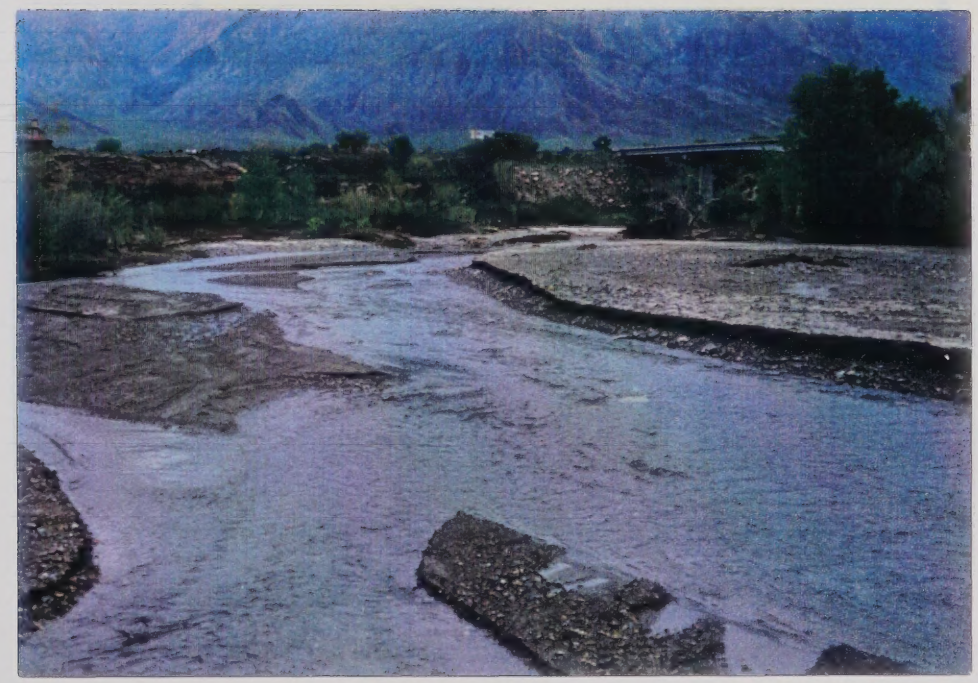


Figure 8. Photos taken on 3/20/95 showing effects of major flood during winter, 1995.



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